

SOME THOUGHTS ON THE FUTURE OF THE GBYP

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SUMMARY

This paper presents a discussion on the future of the successful ICCAT Atlantic wide research programme for bluefin tuna (GBYP), that has improved the information base and models for the Atlantic Bluefin (BFT) stock assessments. The GBYP has demonstrated the need, achievability and value of having coordinated, dedicated and centralized research and data gathering programs. Several of the accomplishments require continuous commitment as they are essential on-going inputs. The paper identifies and discusses the basic continuing data inputs and long-term research needs for the BFT stock assessments and provision of management advice. If the Commission is serious about having reliable and robust stock assessments and management advice for BFT, it must decide on how to proceed so that these inputs and research requirements can be accomplished. It is proposed that the GBYP be continued and form the comprehensive umbrella for providing scientific inputs, including long-term institutional arrangements that must be transformed into routine monitoring programs and continuation of the GBYP's aimed at understanding of the key biological and ecological processes. Approaches for institutionalizing the work, including funding, are discussed.

RÉSUMÉ

Ce document présente une discussion sur l'avenir du programme de recherche sur le thon rouge englobant tout l'Atlantique (ICCAT-GBYP), qui a amélioré la base des informations et les modèles pour les évaluations des stocks de thon rouge de l'Atlantique. Le GBYP a démontré le besoin, la réalisabilité et la valeur d'avoir des programmes de recherche et de collecte de données coordonnés, dédiés et centralisés. Plusieurs des réalisations exigent un engagement incessant, car elles sont des contributions essentielles continues. Le document identifie et discute des données d'entrée continues et de base et des besoins de recherche à long terme pour les évaluations des stocks de thon rouge et la formulation d'avis de gestion. Si la Commission tient sérieusement à avoir des évaluations de stocks et des avis de gestion pour le thon rouge fiables et robustes, elle devra décider de la manière de procéder afin que les besoins en matière de données d'entrée et de recherche puissent être comblés. Il est proposé que le GBYP se poursuive et constitue une plateforme globale pour fournir les données d'entrée scientifiques, y compris des arrangements institutionnels à long terme qui doivent être transformés en programmes de suivi de routine et la poursuite du GBYP visant à comprendre les processus biologiques et écologiques clés. Les approches en vue d'institutionnaliser le travail, y compris le financement, sont discutées.

RESUMEN

Este documento presenta una discusión sobre el futuro del Programa ICCAT de investigación sobre atún rojo para todo el Atlántico (GBYP), que ha mejorado la información de base y los modelos para las evaluaciones del stock de atún rojo del Atlántico. El GBYP ha demostrado la necesidad, la posibilidad de lograrlo y el valor de contar con programas de recopilación de datos e investigación centralizados y dedicados. Varios de los logros alcanzados requieren un compromiso continuo ya que son datos de entrada esenciales y continuos. El documento identifica y debate los datos de entrada continuos y básicos y las necesidades de investigación a largo plazo para las evaluaciones del stock de atún rojo y el asesoramiento de ordenación. Si

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la Comisión seriamente quiere contar con evaluaciones de stock y con un asesoramiento de ordenación robustos y fiables para el atún rojo, debe decidir sobre cómo proceder para que puedan lograrse estos requisitos en cuanto a datos de entrada e investigación. Se propone que el GBYP continúe y forme un paraguas amplio para proporcionar aportaciones científicas, lo que incluye acuerdos institucionales a largo plazo que deben transformarse en programas de seguimiento rutinarios, y la continuación del GBYP destinada a comprender los procesos biológicos y ecológicos clave. Se discuten los enfoques para institucionalizar el trabajo, lo que incluye la financiación.

KEYWORDS

Bluefin tuna, ICCAT, historical data, market data, biological analyses, tagging, genetics, maturity, microchemistry, aerial survey, modelling, Mediterranean Sea, Atlantic Ocean

1. Introduction

The ICCAT Atlantic wide research programme for Bluefin Tuna (GBYP) was established in 2009 in recognition of the need to improve the information base and models for the assessment and provision of scientific management advice for the Atlantic Bluefin (BFT) Tuna resource. The program has been highly successful (e.g. see most the recent review report – Sissenwine and Pierce, 2017 (*In press.*)), but there been problems both in implementation and achievement of some objectives. The most substantive of these has been the inability to successfully develop a reliable approach for providing a fishery independent abundance measure in spite of a large amount of high quality research effort direct towards achieving it. The issues reflect a combination of the difficult challenge of scale for wide-ranging species such as BFT as well as the political, administrative and logistical constraints within which the program had to operate⁴.

Reliable stock assessments and management advice require three basic components:

1. A basic understanding of key biological and ecological processes under which the stock and fishery operate (e.g. stock structure, mixing rates, maturity and reproductive potential, etc.)
2. Time series of basic data for input into the stock assessment (e.g. catches; stock origin, size and age composition; measures of abundances), and
3. An assessment model that integrates the above two components to provide estimates of current status relative to management objectives and advice on the consequences of possible different management actions.

Meeting these requirements requires a continuous and long-term commitment, including consistent funding. ICCAT has generally relied on the data, research and modelling needs for stocks to be undertaken by the member scientists from the Contracting Parties (CPs). There are limitations to the extent that the work can be fulfilled using this approach. This relates to the extent and the location where work needs to be done, the need for consistency and uniformity, varying degrees of expertise and differences in funding, priorities and resources among the various CPs. The establishment of the GBYP was a recognition that a more centralized and coordinated approach was needed. Simply relying on the CPs to provide all the required inputs was not working. Indeed, most RFMOs have similarly found that the data and research requirements cannot be met solely by member scientists and are using RFMO conducted programs (e.g. IOTTC, CCSBT and IATTC).

The GBYP has been successful in improving the information and modelling base for BFT assessment. It is time to ensure that the gains are not lost and to establish a long term framework, including funding, for ensuring that the provision of basic needs for the assessment and scientific management advice for BFT. It is proposed that the GBYP should be continued and form the comprehensive umbrella for providing the scientific inputs. This would entail developing long-term institutional arrangements for those components that now need to be transformed into routine monitorings well as the continuation of the GBYP's current research aimed at understanding of the key biological and ecological processes.

⁴e.g. PIT tags and lack of access for tag seeding; also see Appendix XX from the 2016 GBYP SC Report on the Aerial Survey.

2. Essential/priority on-going data collection needs

Inputs needed on a regular timeframe and in a consistent manner.

2.1 Total catch

Estimates of total catches are the most basic data requirement for any stock assessment. For a species with more than one stock, catch information on the general location relative to stock areas and mixing is also required. Total catches should include all fishery induced mortality (e.g. discards, towing mortality, etc.) and not just landed catches. This information must be provided on a regular (generally annual) basis and for scientific purposes it must be reasonably accurate and consistently estimated. In ICCAT, this basic information is supplied by CPs (i.e. Task 1 data) and is a basic membership responsibility. As such, data for estimating annual catches are available and form the basis for estimating total catches for use in the assessments.

Nevertheless, unreported catches are an issue for many, if not most, fisheries worldwide and the problem is exasperated in quota managed fisheries, particularly for a high valued species such as BFT. Thus, for example, very substantial unreported catches were found to have occurred in fisheries for Southern bluefin tuna for over a decade (Polacheck, 2012 and references therein). The SCRS similarly found that there were large unreported catches for Eastern Bluefin Tuna in the recent past and, although progress has been made towards reducing unreported catches, the potential for unreported catch still exists. Failure to account for such unreported catches will have substantial implications on the reliability of the stock assessments and the subsequent management advice. It is also important from the scientific perspective that information is collected to verify estimates of total catches and to take into account the uncertainty associated with estimates of total catches being used in the assessments. Collection of such data is often problematical but should be undertaken to the extent possible. Market data are one potential method to cross-check and the GBYP has undertaken some work along this line. These market data should be routinely collected and examined to cross check the levels of reported catches. Import and export data are another source of data which may provide an indication of the existence of possible unreported catches. Observer data and comparison of catch rates from vessels with and without observers is another potential source of information.

The three main potential sources of unreported catches for Atlantic bluefin tuna are: (1) catches in the South Atlantic by CPs and non-members for which no quota allocation exists; (2) bycatches in fisheries not targeting BFT and (3) under-reporting of catches within the managed BFT fisheries. Anecdotal information and direct observations (e.g. observations in local markets and landing sites) indicated that the first two occur, but whether the magnitude is substantive or not is unknown. Within the Mediterranean managed BFT fisheries, the fact that most catches are now transferred to farming cages along with the collection of stereo video coverage of the transfers greatly reduces the potential for unreported catches (see below), but mortality during the catching and towing processes need to be accounted for. For the non-farm catches, ensuring reasonable levels of observer coverage and collection and provision of appropriate data by them is probably the most effective approach. It is critical that such observer data are available for scientific purposes and their analyses would be appropriate within the context of the objectives of the GBYP.

As unreported catches also have implications relative to compliance and management issues, how and who should be collecting the data and addressing the issues needs to be coordinated and a unified strategy should be developed. Within this, there is scope for scientific and GBYP contributions. It is critical that the Commission recognizes the issue and adopts a strategy for addressing it.

2.2 Size composition of the catch

The size composition of the catch is another essential input for stock assessment, particularly for relatively long lived species such as BFT. Currently the bulk of the catch for the eastern stock is taken for farming. As the Commission has instituted mandatory stereo video filming for the eastern stock, it should be possible to obtain both very precise and accurate estimates of the size composition for these catches. However, for this to occur, it is essential that standardized methods of recording are used and that a consistent, reliable and statistically valid approach (e.g. sub-sampling of the recording, appropriate combining of data across farms) is used to estimate the size distributions from these recording. The development of these still needs work as well as formalizing how this is to be done on an on-going (i.e. annual) basis. This would be appropriate tasks to be included within an on-going GBYP.

2.3 Age Length Key

Size data, by-themselves are inadequate for a stock assessment for a species such as BFT. This is because size, by itself, provides little or no information on the age of older/larger animals since the length of animals of different ages overlap greatly. It is the age-structure of the catch that provides information on relative cohort strength overtime. In order to be able to estimate the age structure of the catch accurate age/length keys with sufficient precision need to be constructed. These need to be undertaken on an annual basis as age distribution within a size class will vary greatly overtime reflecting the changes in the actual population (e.g. different cohort strength). The GBYP has been successful in being able to develop methods for the collection of otoliths and standardizing the reading of these for age. However, there is a need to turn this into a routine and on-going process including a cost effective approach for the collection of the otoliths in a representative fashion. This will require institutionalizing both their collection and their reading to ensure that both sufficient number of samples across the principle fisheries are collected annually and that the age-reading is consistent and accurate. There needs to be an expectation and/or requirement that fishermen and farmers will allow access for sampling of otoliths and that cost-effective approaches are utilized. It should be noted that, in other bluefin fisheries, otoliths are routinely collected from the catches and that this does not have a detrimental effect on the value of the fish (both for frozen and fresh fish). In cases where there are substantive non-farm catches, the sampling of otoliths needs to be done at the time of catch by observers or at the time of landing. It is also essential that the length of the fish from which the otolith was collected be measured and recorded accurately and consistently over time.

2.4 Stock origin of the catch

In a mixed, multi-stock fishery, it is critical to be able to estimate the proportion of the catch coming from the different stocks. Where catches are taken from areas where stocks overlap, estimates are required of the proportion of the catch that comes from the different stocks. As these proportions are unlikely to remain constant over time owing to variations in the environment and in the relative abundance of the different stocks, there is a need to estimate the stock origin of the catches on a regular and ongoing basis. Genetic procedures have evolved so that estimating stock origin can be done routinely and cost-effectively and requires only obtaining very small tissue samples.

There is strong evidence (both genetic and micro-chemistry) supporting the existence of an eastern and western BFT stock with substantive mixing of the two stocks in catches from several parts of the Atlantic. While not fully definitive, the data are increasingly supportive of a single stock within the Mediterranean. If this is in fact the conclusion, then the need for sampling would be greatly simplified as there would be no need to obtain samples for stock origin from within the Mediterranean, which is where the bulk of the eastern stock catches are taken. However, there is still a need for sampling from fisheries in the Atlantic. This is particularly so for the fisheries in the Western Atlantic as the level of catches coming from the eastern stock would have significant implications for the assessment of this stock. There is a need to establish an on-going biological sampling framework and an institutional approach for their analysis.

2.5 Abundance measure (fishery independent index)

A fundamental input for the stock assessment is at least one measure of its abundance; either an index of relative changes in abundance overtime or an estimate of absolute abundance. The traditional and current inputs for the BFT assessment are primarily CPUE based. The problems and dangers associated with CPUE indices are well known and documented. These are further exasperated when there are a variety of fisheries and fishing methods which are not spatially comprehensive with relatively little overlap. CPUE based from purse seine fisheries (which constitute the bulk of the eastern stock catches) are particularly problematic. Recognition of the problem with CPUE indices was one of the motivations for establishing the GBYP and the development of a fishery independent abundance measure was among its highest priorities. Developing a fishery independent abundance measure for a wide-ranging pelagic species such as BFT is a substantial and difficult challenge. While substantive efforts have been accomplished by the GBYP, to date a reliable approach is still an active area of research and development (see below). Nevertheless, there needs to be a recognition that whatever approach is developed will require that it be undertaken on a regular and continuous basis. As such, consideration needs to be given to the institutional framework and funding for doing this.

2.6 Model refinement and processing

Stock assessments are required on a regular basis (including calculations for a management procedure if the Commission adopts one for BFT). It is important that there is continuity and appropriate expertise in processing

of the data, running the model, maintaining the computer code and verification of the outputs. Additional refinements of the models will inevitably be required as additional data and information become available. The experience with improving the stock assessment and developing an operating model within the GBYP has demonstrated the importance of having dedicated resources for this purpose, particularly as the complexity of the models and output has increased in response to improved understanding of BFT biology, additional data, demands to provide estimates of uncertainty and for being able to evaluate management procedures.

3. Priority research needs

3.1 Development of implementable fishery independent abundance measure

The GBYP has devoted substantive efforts into trying to develop a fishery independent abundance measure for BFT. These have been primarily centred on conventional tagging and aerial surveying. Neither approach has proven fully successful so far. While conceptually both approaches should be able to produce reliable estimates, serious and substantive problems have been encountered with implementing them stemming from logistical, political and administrative constraints compounded by the complexity and variability in BFT behaviour and biology (see GBYP SC reports). Currently, based on recommendations from the GBYP SC, both approaches have been suspended. However, there is still a critical need for a reliable fishery independent index, particularly for the Eastern Atlantic and Mediterranean where the assessment is now driven by two CPUE indices with very limited spatial coverage and likely unaccounted for changes in operations. This should remain a priority research activity for the GBYP.

The GBYP is currently evaluating two alternative approaches (Close Kin Genetic Tagging and Larval Surveys) as well as continuing to assess whether there may be a feasible way to implement a viable and reliable aerial survey.

Close Kin Genetic Tagging (CKGT), which perhaps more appropriately called Close Kin Mark-Recapture (CKMR), would appear the most promising approach at this point. It should be noted that this method is relatively new and was not available when the GBYP was initiated. It is only in the last few years that the method has been well developed, tested and shown to be able to produce reliable and useful results. There are several advantages (but also some significant challenges) to this approach over the other methods under consideration. These include:

- It provides an estimate of absolute abundance. Thus, a single estimate will be highly informative for the stock assessment compared to relative abundance indices which require a time series of 5-10 years of estimates and still can leave large uncertainties about the absolute stock sizes. As such, it has a much more immediate ability to improve the stock assessment as well as providing an ongoing input.
- Sampling and data can be combined across years. Thus, with accumulation of the more data and more years, the estimates improve (unlike with traditional survey approaches).
- Where appropriate fisheries exist (e.g. ones on the adult and YOY or juveniles), sampling can be undertaken on the landed catch. This eliminates the need for expensive and difficult-to-implement field programs. Also, the biological sampling does not interfere with the commercial value of the catch. In the case of BFT, the adult purse seine and trap fisheries could provide adequate and sufficient samples (and could easily be cost effectively incorporated within the responsibilities of the MRAG observers). While YOY or juvenile sampling are likely to require dedicated field sampling programs, these can be accomplished at reasonable costs using small vessels inshore and without many of the implementation problems involved in more wide-scale approaches. Nevertheless, cooperation from relevant CP's for permitting the sampling activity will be required.
- As well as an abundance measure, the approach provides additional and critical information on reproductive contribution and stock structure. Additionally, with a sufficient time series of data, estimates of natural mortality can be obtained. This contrasts with survey based approaches where only a single type of information (e.g. on relative abundance) is obtained.
- The sampling requirements dovetail with other biological sampling required for the assessment (e.g. aging and stock origin). Thus, a common approach (with obvious efficiencies) can be used.
- Genetic processing methods have improved tremendously in recent years and are likely to continue to do so. This means that the actual analyses costs to undertake the processing of the large number of samples is no longer prohibitive and is likely to continue to decrease.

- The apparent lack of substantive stock or sub-stock structure within the Mediterranean greatly simplifies the sampling requirements and complexity of estimation, which has been one major concern with attempting to utilize this approach with BFT.

The successful implementation of the CKMR approach requires high quality, careful and consistent sampling and genetic analytical methods. Moreover, a large number of samples are required, both from the fishery and from surveys of the young-of-the-year (or larvae). As such an appropriate framework and institutional are essential.

Larvae surveys are the other alternative approach being considered. However, this approach suffers from many of the implementation issues and problems encountered with both conventional tagging and the aerial survey, although these may be more easily overcome with a ship based and non-fish catching survey. However, ship time is expensive and the cost for a survey with adequate spatial and temporal coverage are likely to be very high, if not prohibitive.

The aerial survey remains a possible approach and its potential should not be discarded completely. However, given the reasons that the survey was suspended (see GBYP SC Report, 2016), overcoming the issues and problems would be very difficult. Substantially more resources are likely to be required to simply reduce the estimation CV's within an area without knowing whether in fact a viable index could be achieved (i.e. whether the amount of process error across years which has been observed so far is actually of this magnitude and thus render a relatively uninformative index). Also, it is not clear whether there exists feasible and viable ways to overcome the several implementation issues that have compromised the past surveys.

3.2 Relative reproduction contribution

The default in most stock assessments is that reproductive output is directly proportional to the weight of spawning fish. However, several recent studies suggest that in fact reproduction contribution often increases more than weight with length or age. This can have important implications for estimating spawn and recruit relationships, the actual status of the spawning stock and fishery management and fishery interactions. There also remains uncertainty about the spawning frequency ogives for BFT. These are not easy issues to resolve and often require extensive sampling over wide geographic areas. However, a by-product of a CKGT for estimating abundance is that it can provide information and estimates on relative spawning contribution with age. At this point, and given available resources, CKGT is probably the most cost-effective approach for addressing these issues.

3.3 Resolving stock structure within the Med

A lot of data have been collected by the GBYP regarding the possible stock structure within the Mediterranean. Analyses of these data suggest that in fact there is no stock or sub-stock structure and that there is a lot of mixing of individuals among spawning areas and areas of different fisheries. However, some scientists still consider that the possibility of stock structure within the Mediterranean is a plausible hypothesis. A comprehensive and integrated analyses of all the available data needs to be completed to resolve this question and to the degree, if any, of plausibility, that could be afforded to hypotheses of stock structure within the Mediterranean. The analyses need to include an estimate of the power of the existing data to detect stock structure if in fact it did exist.

3.4 Spatial dynamics and fishery interactions

The GBYP has collected a large amount of data which has provided insights into the complex spatial dynamics of BFT. These include electronic tagging, genetic and micro-chemistry data. This information is important for understanding the impacts of different fisheries on the two or possibly more stock components for this species. The data are also being used in conditioning the operating model that is now under development. A better understanding of the complex dynamics is required for the development of more realistic models that take into account the spatial components of the fisheries and of the fish and the provision of management advice that takes into account the mixed spawning stocks taken in different fisheries. At this point there is a need to consolidate the existing information and develop a research plan to provide some guidance and structure to further works, particularly the release of electronic tags (which to date has been somewhat opportunistic).

3.5 Existence of substantial spawning areas outside the Mediterranean

Over the years, there have been several reports of BFT larvae and YOY fish having been found outside of the Gulf of Mexico and the Mediterranean (Di Natale, 2017 (*In press*)). The amount of actual surveying effort has been relatively small and ad-hoc. As this point, it is not clear whether these larvae and YOY represent irregular, sporadic and infrequent spawning events or whether in fact there is substantive spawning in these areas and additional stocks of BFT (or were in the past and no longer exist due to the effects of fishing). Resolution of this question is clearly important both for the stock assessment and management of the resource. If there is substantial spawning outside of the Gulf of Mexico and the Mediterranean, the degree of mixing both on the fishing grounds and among the spawning areas is also critical. Research is clearly needed on this issue. However, the best approach for resolving this question is not clear nor the relative priority. The priority to be given to research that could resolve the question of whether substantial spawning needs to be determined taking into account both the cost (which are likely to be high) and the potential impacts on current management if they exist.(i.e. the risk of not knowing).

3.6 Data mining

The GBYP has successfully undertaken extensive data mining for the recovery/provision of historical data that have not been previously available to ICCAT, but which contain relevant information for understanding BFT and the stock assessments. It would seem that the bulk of informative data that can be feasibly recovered has been completed. Nevertheless, there potentially remain some relevant and important data sets that should still be included within the research activities of the GBYP. These include:

- a) Electronic tagging data sets
- b) Historic Museum Specimens or other stored samples suitable for Genetic Analyses Particularly outside of the Mediterranean (initial inventory)
- c) Historical Plankton Survey Collections (inventory what exists relative to potential to provide BFT larvae)

3.7 Management procedure evaluation

The GBYP has been involved in the development of an operating model and commencement of the evaluation of management strategies based on the operating model (MSE). The MSE approach is seen as the best way to improve and provide robust management advice. This work is still in progress and needs to be finalized.

3.8 Natural mortality

Natural mortality rates are one of the critical parameters for stock assessments, and yet are notoriously difficult to estimate. Stock assessment results can be highly sensitive to the actual values assumed, therefore estimation of natural mortality rates remains a key research challenge. Tagging methods are perhaps the only approach cable of producing direct estimates without discontinuing the fishery. The experience during the GBYP attempt to implement a large scale conventional tagging program indicates that this is not a viable approach for BFT (at least at this point in time) owing to several logistical constraints. However, if CKGT is undertaken and proves feasible on a long-term basis (including overcoming administrative and logistical issues with its implementation), then it has the potential to generate direct estimates of natural mortality rates.

4. Institutionalization of basic inputs into the stock assessment and management procedures

There is a clear need for on-going, long-term data collection and analyses of biological samples in order to provide a robust stock assessment and reliable scientific advice for management. It is imperative that a workable and feasible approach be developed so that the data and inputs are consistently and regularly collected. The opportunity for collecting this important information only exists in real time. If the data are not collected for a year or an area, there is no retrospective way to obtain them. The more data gaps the larger the uncertainty and at some point the stock assessment becomes untenable.

Similarly, there are critical and extensive research issues that need to be resolved. The research is complex and requires continuity, work over-extensive geographic areas (i.e. beyond the scale of the EEZ of any single CP and including the high seas) and time commitments spanning several years, at a minimum. If the Commission is serious about making progress on these issues, a long-term strategy and institutional frameworks for how to conduct the work is required

4.1 Approaches for institutionalizing including funding

There are four basic approaches that could be considered for conducting the routine data collection and research needs identified above:

1. Relying on CPs;
2. Annual Tendering of Work;
3. Long-term MOU and Contracting Arrangements (e.g. similar to the MRAG observers);
4. "In-house" - i.e. develop the expertise and infra-structure for doing the work within the ICCAT Secretariat.

To date, ICCAT has almost exclusively used the first two of these. While there is scope for the first two of these to be continued to be used, the experiences of the GBYP and of attempting to meet the general data needs for stock assessments within ICCAT have shown that neither of these are likely to be adequate, efficient and cost-effective. There is a need to establish approaches that can allow for long-term perspective and continuity for the work. This is particularly true for the ensuring the provision of the on-going basic inputs for the stock assessment but also for research activities that require multi-year perspective.

The last of these approaches has been successfully used by some RFMOs (most notably IATTC and the Halibut Commission). It has a number of advantages in terms of ensuring that the work gets done with consistency and to appropriate standards, etc. However it would entail large initial investment in infra-structure and employees, some of which may not be needed on a full time basis. It would also entail a major rethink of the role and structure of the Secretariat.

The other approach of developing and relying on long term arrangement with appropriate research institutions or private companies would be easier to develop and there are some precedents within ICCAT. However, cost in the longer term may be hard to contain as well as ensuring quality, preventing divergences in objectives and priorities, and keeping costs fair and reasonable.

4.2 Funding options (assuming that a significant amount of the work will not be done solely by CPs)

Long term funding arrangements are critical for ensuring that stock assessment inputs and research needs are met. Whether any long term and institutional arrangements can be viable is dependent upon having an appropriate funding structure. Possible approaches include:

1. Building research funding into the Annual ICCAT Budget and CP's Contribution
2. Voluntary Contributions
3. Dedicated BFT Levy/Mandatory Contribution
4. Dedicated Monitoring/Research Quota

The first of these would arguably be the most effective way to facilitate long-term planning as it would ensure a reliable and predictable source of funds. However, it would require some structural changes to the ICCAT Secretariat and may require a renegotiation of the terms of the current Convention. The second option essentially reflects the current situation of the GBYP, which lacks any sort of assurance on the availability and continuity of funds (making it difficult to develop long-term programs). In addition, managing the different requirements imposed by the funding mechanisms used by different CPs has proven rather challenging and often results in a situation where even short-term calls for tender and the resulting contracts are rushed to completion, which is not always conducive to providing the best quality science.

The third approach, a dedicated BFT levy, reflects a user pay approach and is similar in-principle to the funding of the MRAG observers. The levy could be based on quota allocations and other considerations [e.g. those not involved in farming may not need to contribute to the expense of collecting otoliths from farms]. This would seem to be a tenable approach based on the successful implementation of the ICCAT Regional Observer Program under Recommendations 13-07 and 14-04.

The fourth approach, a dedicated research quota, is an indirect user pay approach where part of the annual quota is set aside to be sold at auction (or by other agreed means) with the proceeds used in support of research and long-term data collection. This approach has the advantage of not requiring individual CPs to produce funds directly. The Commission considered this approach in the past with mixed reviews, and has not yet elected to implement the approach. Nevertheless, in our view this remains a viable alternative to option 3.

5. Conclusion

The GBYP has been highly successful in improving the information and data base for the BFT stock assessment and provision of management advice. It has demonstrated the need, achievability and value of having coordinated, dedicated and centralized research and data gathering programs. Several of the accomplishments of the program are essential for improving the stock assessment and need to be operationalized, which requires continuous long-term commitments. There is also a critical need to continue the research component of the GBYP as there is still much to learn about the biology and behaviour of Bluefin tuna for improving the stock assessments. The research needs require dedicated multi-year effort and continuity in the process is required. If the Commission is serious about having reliable and robust stock assessments and management advice for BFT, it needs to decide on how to proceed so that the on-going inputs and research requirements can be accomplished. The development of long-term structural and funding arrangements should be a high priority of the Commission.

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